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An Operating Unit of Analytic Services Inc.



SBinet Independent Assessment: Analysis of Alternatives, Phase IA

Presented to: SBinet AoA Executive Steering Committee

Presenter: (b) (6), (b) (7)(C), SBinet AoA Lead

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Homeland Security Studies and Analysis Institute

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The Institute’s research is undertaken by mutual consent with DHS and is organized as a set of discrete tasks. This report presents the results of research and analysis conducted under

Task 10-27, SBInet Block 1 Analysis of Alternatives

The purpose of the task is to conduct an Analysis of Alternatives that will assist the study sponsor (Executive Director, SBI), the Office of Border Patrol, and the Component Acquisition Executive (CAE) in their efforts to make a decision concerning the continued deployment of SBInet Block 1 technologies along the Southwest border. This decision, which constitutes acquisition decision event 3 (ADE 3) is expected to be made in March 2011.

The results presented in this report do not necessarily reflect official DHS opinion or policy.

For information about this publication or other HSSAI research, contact

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Outline

■ Introduction

- Background
- Schedule and Status
- Scope / Limitations
- General Approach
- Data and Assumptions

■ Alternatives

■ Effectiveness Analysis

■ Cost Analysis

■ Summary

■ Next Steps

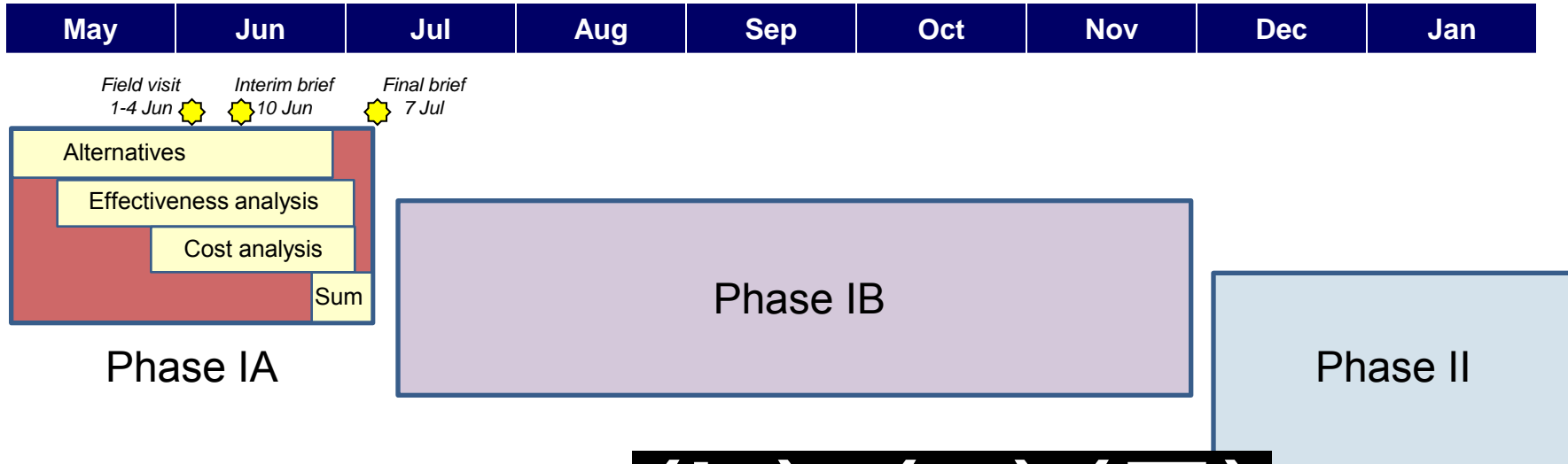
Background

[Due] to my ongoing concerns about SBInet, I ... ordered a departmentwide reassessment of the program to consider options that may more efficiently, effectively and economically meet our border security needs.

-- DHS Secretary Janet Napolitano, 15 Jan 10

- **The Department is considering two questions:**
 - *"Is the SBInet system viable?"*
 - Conduct system acceptance testing and Independent Operational Test and Evaluation (IOT&E) of Block1 deployments
 - *"If so, is it worth the cost?"*
 - Perform an **Analysis of Alternatives (AoA)** to compare the cost and effectiveness of other technology options
- **This briefing presents the results of AoA Phase IA**

AoA Schedule and Status



Phase IA (near-term,
with focus on Arizona)
is complete

(b) (7)(E)

Scope

| AoA Focus Area | Phase IA (7 May – 30 Jun 2010) | Later Phases |
|---------------------|--|--|
| Solution | Technology (vice personnel and tactical infrastructure) | |
| Mission | Situational Awareness (vice apprehension, transportation, detention) | |
| Geographic | <ul style="list-style-type: none"> • Arizona | <ul style="list-style-type: none"> • Other SW Border Areas |
| Decision | <ul style="list-style-type: none"> • SBInet program, budget, and contract (Fall 2010) | <ul style="list-style-type: none"> • Most appropriate technology alternatives |
| Time Horizon | <ul style="list-style-type: none"> • Systems in use, 2010 • Mature technologies specified by DHS | <ul style="list-style-type: none"> • Systems deployable before 2014 • Wide range of technologies |

Limitations

■ The AoA does:

- Assess different technology approaches
- Identify key factors in choosing a technology approach
- Assume existing test results are valid and leverage experience from current SBInet deployments
- Compare alternatives on the basis of how well they provide situational awareness
- Take the perspective that “good” situational awareness contributes to timely response and apprehension
- Consider the adaptive nature of the adversary
- Consider pedestrian and vehicle crossings above ground



■ The AoA does not:

- Identify the optimal combination of specific equipment / systems
- Engineer the details of any technology solution
- Independently analyze SBInet test results or measure SBInet technical performance
- Measure the contribution of situational awareness to achieving control of the border
- Quantify the number of apprehensions that may result from the deployment of any technology solution
- Predict the adversary's response to any specific technology deployment
- Consider non-traditional means of entry (tunnels, ultralight aircraft)

Phase IA, General Approach

- Analyze AZ border; identify key features that affect choice of technology approach
- Select representative areas (A-D) for detailed analysis and compare alternatives
- Draw appropriate conclusions and apply insights across entire

(b) (7)(E)

Note: (b) (7)(E)

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Data Types and Sources

| | Types | Sources |
|------------------------------|--------------------------------------|---|
| Technical Performance | Hand-held equipment | Lab and (limited) field test data |
| | SBNnet and mobile (b) (7)(E) systems | TUS-1 early ops, Block 1 testing, and system specs |
| | UAVs/UASs | CBP-sponsored testing |
| | Other systems | OBP Agent Support Equipment Catalog |
| Cost | Hand-held equipment | OBP Office of Information Technology |
| | SBNnet and mobile (b) (7)(E) systems | SBNnet Program Office |
| | UAVs | OBP Office of Air & Marine |
| | Personnel | CBP website; Office of Personnel Management (OPM) |
| | Other | Federal costing guidance; industry sources, including Price Systems True Planning® Parametric Cost Model knowledge base |
| Operations | [All] | BPETS*; ORBPP reports*; field visits |
| Environment | Terrain , elevation | USGS DTED* Level 1 and DEM* (1 arcsec resolution) |
| | Ravines and canyons | US Census Bureau, TIGER “stream” files |
| | Vegetation, weather and climate | N/A: not modeled |

(b) (7)(E)

USGS = US Geological Survey

DTED = Digital Terrain Elevation Data

DEM = Digital Elevation Model

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Major Assumptions

- **Current and planned capabilities remain in place as part of the study baseline**
 - SBInet TUS-1 and AJO-1 deployments are completed
 - Personnel and tactical infrastructure are “given”
- **The comparison of alternatives is not impacted by**
 - Special operations (e.g., Operation (b) (7)(E))
 - Existing fixed- and rotary-wing air support ((b) (7)(E) , etc.)
 - Current voice communications (improved comms would be beneficial in all cases, regardless of which alternative is chosen)
- **Measures of effectiveness for a technology solution do not depend on**
 - The type of illegal activity (alien smuggling, narcotics smuggling, etc.)
 - The volume of illegal traffic

Outline

■ Introduction

■ Alternatives

- What is an Alternative?
- Four Alternatives
- Variations, Mixes, Hybrids
- Detailed Description of Alternatives

■ Effectiveness Analysis

■ Cost Analysis

■ Summary

■ Next Steps

What is an Alternative?

- **An Alternative is a “technology approach”**
 - Platform-centric strategy (e.g., "from the air," "from fixed ground locations," etc.)
 - AoA Phase IA considers one example of each
- **Each Alternative**
 - Starts with the same baseline of existing personnel, tactical infrastructure, and equipment
 - Adds systems and operators, using one of four technology approaches, to address current gaps in situational awareness
 - Includes a high-level concept of employment that describes how information is collected and used

Four Alternatives

Platform and Operator Investment

■ Alt 3: Mobile

- (b) (7)(E) (b) (7)(E)
- (b) (7)(E)

■ Alt 4: Aviation-Centric

- (b) (7)(E) (b) (7)(E)
- (b) (7)(E)

Note: (b) (7)(E) acquired over a period of 2 years

■ Alt 1: Agent-Centric

- Upgrades equipment (b) (7)(E)
 - (b) (7)(E)
 - (b) (7)(E)
 - (b) (7)(E)
- Agents share information via radio

■ Alt 2: Fixed

- (b) (7)(E) (b) (7)(E)
- (b) (7)(E)
- (b) (7)(E)

Command and Control (C2) Investment

Axes are conceptual only: the positions of the alternatives are not shown to scale.

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Variants, Mixes, Hybrids

| | Definition | Example | Included in Phase 1A? |
|-----------------|---|---|---------------------------|
| Variants | (b) (7)(E) | (b) (7)(E) | No (time) |
| | | | No (time/decision focus*) |
| | | | No (time/near-term focus) |
| | | No common operating picture in Alt 2 (Fixed) | No (time) |
| Mixes | Choose different technology approaches in different areas | Example: choose Alt 2 in Area A and Alt 3 in Area B | Yes |
| Hybrids | Combine multiple technology approaches within the same area | (b) (7)(E) | No (time) |

(b) (7)(E)

Baseline Assets

(b) (7)(E)

Alternative Asset Laydowns

Area A - (b) (7)(E)

(b) (7)(E)

Alternative Asset Laydowns

Area B – (b) (7)(E)

(b) (7)(E)

Alternative Asset Laydowns

Area C - (b) (7)(E)

(b) (7)(E)

Alternative Asset Laydowns

Area D - (b) (7)(E)

(b) (7)(E)

Alternative Asset Laydowns

All Analysis Areas A-D; Alternative 4

| Area of Detailed Analysis | Alt 4 (Aviation-Centric) | | | | |
|-----------------------------|----------------------------------|---------------------------------------|---------------------------------------|---------------------------------|-------------------------------|
| | Analysis area (mi ²) | Entire station AOR (mi ²) | Analysis area fraction of station AOR | UAV hr/day over entire station* | UAV hr/day over analysis area |
| <u>Area A</u> (b) (7)(E) | (b) | (7) | (E) | | |
| <u>Area B</u> (b) (7)(E) | | | | | |
| <u>Area C</u> (b) (7)(E) | | | | | |
| <u>Area D</u> (b) (7)(E) | | | | | |

Assumption: (b) (7)(E)

(b) (7)(E)

Alternatives: Systems Added

| Detailed Analysis Area | Baseline | Alternatives | | | |
|---|------------|------------------------|----------------|-----------------|---------------------------|
| | | Alt 1 Agent-Centric | Alt 2 Fixed | Alt 3 Mobile | Alt 4 Aviation Centric |
| <u>Area A</u> (b) (7)(E) | (b) (7)(E) | | | | |
| <u>Area B</u> (b) (7)(E) (b) (7)(E) | | | | | |
| <u>Area C</u> (b) (7)(E) | | | | | |
| <u>Area D</u> (b) (7)(E) | | | | | |

Outline

- **Introduction**

- **Alternatives**

- **Effectiveness Analysis**

- Measures of Effectiveness
- Inputs
- Sources of Uncertainty
- Detailed Analysis Results
- Summary & Observations

- **Cost Analysis**

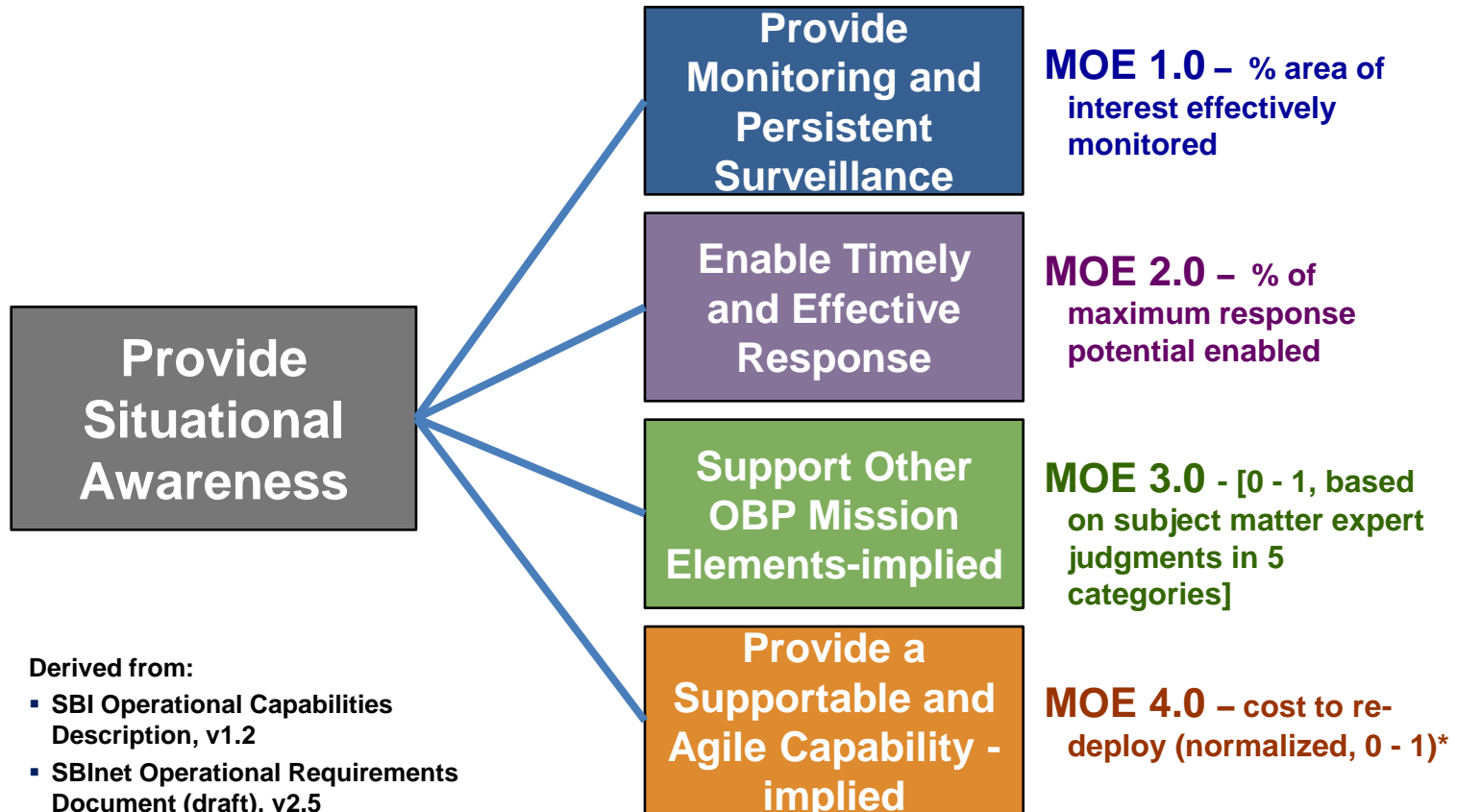
- **Summary**

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Measures of Effectiveness (MOEs)

Mission Objective
Supported by SBInet

Mission Element / MOE



Derived from:

- SBI Operational Capabilities Description, v1.2
- SBInet Operational Requirements Document (draft), v2.5
- SBInet (b) (7)(E) Station CONOPS, v1

*Reliability, maintainability, and availability are subsumed in alternative definitions and life-cycle cost.

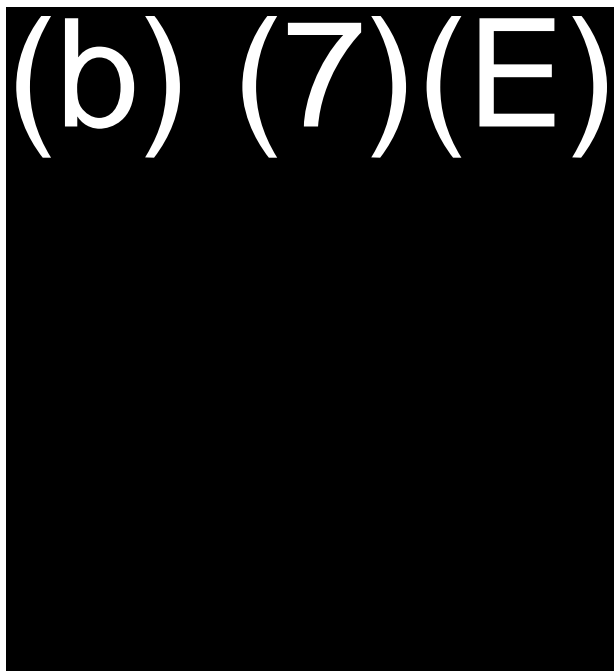
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MOE Weights

- With respect to the top-level objective of providing situational awareness:

(b) (7)(E)



- MOE1.0 - Monitoring and Persistent Surveillance
- MOE2.0 - Enable Timely and Effective Response
- MOE3.0 - Support Other OBP Mission Elements (implied)
- MOE4.0 - Provide a Supportable and Agile Capability (implied)

Source: derived from pooled pairwise judgments provided by OBP (SPPA/SWB/OIT/ACQ), 28-30 Jun 2010

Effectiveness Analysis: Inputs

| | Parameter | Input Value | Source/Comment |
|--|-----------|-------------|----------------|
| | (b) | (7) | (E) |

Effectiveness Analysis, Inputs (cont)

| | Parameter | Input Value | Source/Comment |
|------------|-----------|-------------|--|
| (b) (7)(E) | | | Parameter |
| | | | Parameter |
| | | | (b) (7)(E) |
| | | | (b) (7)(E) |
| | | | Assumption, based on same/similar equipment |
| | | | Not modeled in this analysis |
| | | | Based on discussions with CBP Office of Air & Marine (OAM) |
| | | | Representative value |
| | | | Representative value |
| | | | Representative value |
| | | | Representative value |
| | | | (b) (7)(E) |

Outline

- **Introduction**
- **Alternatives**
- **Effectiveness Analysis**
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 - MOE 3.0
 - MOE 4.0
 - MOE 1.0
 - MOE 2.0
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Results: MOE 3.0

All Analysis Areas A-D

(b) (7)(E)

- Deterrence
- Agent Safety
- Asset Security
- Access
- Public Acceptance

Source: derived from pooled pairwise judgments provided by OBP (SPPA/SWB/OIT/ACQ), 28-30 Jun 2010

MOE 3.0:

Support Other OBP Mission Elements

(b) (7)(E)

Alt 1
Agent-Centric

Alt 2
Fixed

Alt 3
Mobile

Alt 4
Aviation-Centric

Scores

| | | Deterrence | Agent Safety | Asset Security | Access | Public Acceptance | MOE 3.0 |
|--------|-------|------------|--------------|----------------|--------|-------------------|---------|
| Weight | | (b) (7)(E) | | | | | |
| Alt 1 | score | | | | | | |
| Alt 2 | score | | | | | | |
| Alt 3 | score | | | | | | |
| Alt 4 | score | | | | | | |

Source: HSSal survey of Tucson and Yuma sector personnel, 21-24 Jun 2010 (b) (7)(E) responses)

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MOE 4.0

- **Approach**

- Agility: ease or difficulty of repositioning the capability, based on shifts in illegal immigration / border crossing trends

- **Measurement**

- Use cost as a surrogate for measuring difficulty
- Normalize to first-deployment cost:

$$\text{MOE 4.0} = (\text{Cost}_{\text{redeploy}} / \text{Cost}_{\text{first deployment}})$$

- First-deployment cost: the one-time, non-recurring cost to acquire the capability and complete the deployment to its initial operating location

MOE 4.0

Ground Rules and Assumptions

■ Geography

- Assume redeployment from (b) (7)(E)

■ Timing

- Move occurs in FY 2015 (midpoint of the 10-year life-cycle)
- Move is completed entirely within FY boundaries
- There is adequate “strategic warning” to allow for the initiation of long-lead actions on the receiving end (e.g., negotiating site access for fixed towers)

■ Cost Allocation

- Assume no other deployments of any other alternatives occur between FY11* and FY15
- Rationale will become clear when we describe the life-cycle cost analysis

MOE 4.0

Ground Rules and Assumptions (cont)

- **From the initial location...**
 - Alternative-unique personnel (additional vehicle/**(b) (7)(E)** operators and flight crews) are permanently re-assigned; baseline personnel remain in place
 - Some equipment is relocated; other items remain in place and must be re-purchased (see “Inputs”)
- **To the new location...**
 - Relocating personnel and equipment “fall in” on existing infrastructure, which is to be capable of supporting the newly-redeployed assets
 - Example: an airfield capable of supporting UAS operations per the description of Alt 4 is assumed to exist
 - Some services must be re-performed (see “Inputs”)

MOE 4.0

Inputs

| Item | Approx Unit Cost (\$K, Then-Year) | Comments |
|----------------------------------|-----------------------------------|---|
| Permanent Change of Station cost | \$18 / person | Assume personnel are able/willing to relocate |
| O&S penalty for equipment move | (b) (4) | |
| “Repurchased” items | | |
| | (b) (7)(E), (b) (4) | |
| Items not included | | |
| Renegotiated UAS mx contract | N/A | Assumes no increase |
| Airfield | N/A | Assumed to be existing and capable of supporting UAS operations |
| Office space | N/A | Assumed sufficient |
| | | |

MOE 4.0

Redeployment and First-Purchase Costs

| Redeployment Cost (\$K) | A (b) (7)(E) | B (b) (7)(E)s | C (b) (7)(E) | D (b) (7)(E) | Notes |
|-------------------------|---------------------|---------------|--------------|--------------|-------|
| Alt 1 Agent-Centric | (b) (7)(E), (b) (4) | | | | |
| Alt 2 Fixed | | | | | |
| Alt 3 Mobile | | | | | |
| Alt 4 Aviation-Centric | | | | | |

| First-Purchase Cost (\$K) | A (b) (7)(E) | B (b) (7)(E) | C (b) (7)(E) | D (b) (7)(E) | Notes |
|---------------------------|--------------|--------------|--------------|--------------|--|
| Alt 1 Agent-Centric | (b) (4) | | | | For additional detail, see the Cost Analysis. |
| Alt 2 Fixed (low) | | | | | Important note: the “low” and “high” figures shown for Alts 2 and 4 do <u>not</u> represent cost risk: all figures are “most likely” estimates. Rather, they represent “allocation uncertainty” – the fact that we do not know the base over which certain non-divisible costs (e.g, a hangar for a UAV that flies over several different areas) must be spread. |
| Alt 2 Fixed (high) | | | | | |
| Alt 3 Mobile | | | | | |
| Alt 4 Aviation-Centric | | | | | |

MOE 4.0

Results

(b) (7) (E)

MOE 4.0: Provide an Agile and Supportable Capability

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MOEs 1.0 and 2.0

$$\text{MOE 1.0} = (A_{\text{coverage}} / A_{\text{Interest}}) * p_{\text{detect}} * p_{\text{ID}} * p_{\text{classify}} * (1 - p_{\text{fail}})$$

(b) (7)(E)

(b) (7)(E)

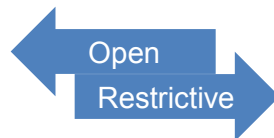
Requires detailed analysis of (b) (7)(E)
Separate analyses for analysis areas A - D

$$\text{MOE 2.0} = (b) (7)(E)$$

(b) (7)(E)

$$\text{MOE 2.0} = p (b) (7)(E)$$

(b) (7)(E)



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MOE 1.0: Calculating Coverage

Area D – (b) (7)(E) Alternatives 1-3

(b) (7)(E)

MOE 1.0: Calculating Coverage

All Analysis Areas (A-D); Alternative 4

(b) (7)(E)

| Area of Detailed Analysis | Alt 4 (Aviation-Centric) | |
|-----------------------------|--------------------------|------------|
| <u>Area A</u> (b) (7)(E) | (b) (7)(E) | (b) (7)(E) |
| <u>Area B</u> (b) (7)(E) | | |
| <u>Area C</u> (b) (7)(E) | | |
| <u>Area D</u> (b) (7)(E) | | |

MOE 1.0 Calculations

Area D – (b) (7)(E)

| Alternative | (b) (7)(E) | A _{coverage} (mi ²) | A _{coverage} / A _{interest} [A _{interest} = 380 mi ²] | p _{detect} | p _{identify} (case L) | p _{classify} (case L) | 1-p _{fail} (case L) | Subtotal | MOE 1.0 | |
|---------------------------|------------|---|---|---------------------|-----------------------------------|-----------------------------------|---------------------------------|----------|---------|--------|
| | | | | | | | | | Case L | Case U |
| Alt 1 Agent-Centric | (b) (7)(E) | | | | | | | | | |
| Alt 2 Fixed | | | | | | | | | | |
| Alt 3 Mobile | | | | | | | | | | |
| Alt 4 Aviation-Centric | | | | | | | | | | |

Case L:

Case U:

(b) (7)(E)

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MOE 1.0 Calculations

Area C – (b) (7)(E)

| Alternative | (b) (7)(E) | A _{coverage} (mi ²) | A _{coverage} / A _{interest} [A _{interest} = 499 mi ²] | p _{detect} | p _{identify} (case L) | p _{classify} (case L) | 1-p _{fail} (case L) | Subtotal | MOE 1.0 | |
|---------------------------|------------|---|---|---------------------|-----------------------------------|-----------------------------------|---------------------------------|----------|---------|--------|
| | | | | | | | | | Case L | Case U |
| Alt 1 Agent-Centric | (b) (7)(E) | | | | | | | | | |
| Alt 2 Fixed | | | | | | | | | | |
| Alt 3 Mobile | | | | | | | | | | |
| Alt 4 Aviation-Centric | | | | | | | | | | |

Case L:

Case U:

(b) (7)(E)

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MOE 1.0 Calculations

Area B – (b) (7)(E)

- Asset laydown in Alt 3 foregoes increased area coverage (MOE 1.0) to minimize costs while maintaining operational reach (MOE 2.0)

| Alternative | (b) (7)(E) | A _{coverage} (mi ²) | A _{coverage} / A _{interest} [A _{interest} = 405 mi ²] | p _{detect} | p _{identify} (case L) | p _{classify} (case L) | 1-p _{fail} | Subtotal | MOE 1.0 | |
|---------------------------|------------|---|---|---------------------|-----------------------------------|-----------------------------------|---------------------|----------|---------|--------|
| | | | | | | | | | Case L | Case U |
| Alt 1 Agent-Centric | (b) (7)(E) | | | | | | | | | |
| Alt 2 Fixed | | | | | | | | | | |
| Alt 3 Mobile | | | | | | | | | | |
| Alt 4 Aviation-Centric | | | | | | | | | | |

Case L:

Case U:

(b) (7)(E)

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MOE 1.0 Calculations

Area A – (b) (7)(E)

| Alternative | (b) (7)(E) | A _{coverage} (mi ²) | A _{coverage} / A _{interest} [A _{interest} = 438 mi ²] | p _{detect} | p _{identify} (case L) | p _{classify} (case L) | 1-p _{fail} (case L) | Subtotal | MOE 1.0 | |
|---------------------------|------------|---|---|---------------------|-----------------------------------|-----------------------------------|---------------------------------|----------|---------|--------|
| | | | | | | | | | Case L | Case U |
| Alt 1 Agent-Centric | (b) (7)(E) | | | | | | | | | |
| Alt 2 Fixed | | | | | | | | | | |
| Alt 3 Mobile | | | | | | | | | | |
| Alt 4 Aviation-Centric | | | | | | | | | | |
| Case L: | (b) (7)(E) | | | | | | | | | |
| Case U: | | | | | | | | | | |

MOE 1.0 Results

All Analysis Areas A-D

(b) (7)(E)

MOE 1.0: Provide Monitoring and Persistent Surveillance

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Area D – (b) (7)(E)

- Determine A_{\max} (maximum area of potential response) for each (b) (7)(E) team, based on access and relative speed

(b) (7)(E)

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MOE 2.0:

(b) (7)(E)

Area D – (b) (7)(E) Alternatives 1-3

- Measure A_{C2} (b) (7)(E)

(b) (7)(E)

MOE 2.0:

(b) (7)(E)

Area B –

(b) (7)(E)

(b) (7)(E)

MOE 2.0: Terrain Detail

(b) (7)(E)

(b) (7)(E)

MOE 2.0: Terrain Characterization

(b) (7)(E)

(b) (7)(E)

MOE 2.0: Baseline Assets

(b) (7)(E)

(b) (7)(E)

MOE 2.0: Baseline Assets

(b) (7)(E)

(b) (7)(E)

MOE 2.0 Results

Sub Areas B-1 and B-3 (b) (7)(E)

(b) (7)(E)

MOE 2.0 Calculation – Other Inputs

Sub Area B1, (b) (7)(E) | Alternative 2

(b) (7)(E)

MOE 2.0 Calculation - Other Inputs (cont)

Sub Area B1, (b) (7)(E) Alternative 3

(b) (7)(E)

MOE 2.0 Calculation - Other Inputs (cont)

Sub Area B1, (b) (7)(E); Alternative 3

(b) (7)(E)

MOE 2.0 Calculation - Other Inputs (cont)

Sub Area B3, (b) (7)(E); Alternative 3

(b) (7)(E)

MOE 2.0 Calculation

Area B – (b) (7)(E); Alternative 4

(b) (7)(E)

MOE 2.0 Results

All Analysis Areas A-D

(b) (7)(E)

MOE 2.0: Enable Timely and Effective Response

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Effectiveness by MOE

Area A - (b) (7)(E)

(b) (7)(E)

Effectiveness by MOE

Area B – (b) (7)(E)

(b) (7)(E)

Effectiveness by MOE

Area C - (b) (7)(E)

(b) (7)(E)

Effectiveness by MOE

Area D - (b) (7)(E)

(b) (7)(E)

Summary Observations

Effectiveness Analysis - General

- **The need for Situational Awareness in border regions includes both strategic and operational / tactical considerations**

- This analysis considers both

- (b) (7)(E)
[Redacted]
[Redacted]
[Redacted]
[Redacted]
 - (b) (7)(E)
[Redacted]
- (b) (7)(E)
[Redacted]
[Redacted]

Summary Observations

Effectiveness Analysis – Alternative Strengths/Weaknesses

- Upgraded (b) (7)(E) (Alt 1)
 - (b) (7)(E)
- Fixed towers plus Common Operational Picture (COP) (Alt 2)

(b) (7)(E)

Summary Observations

Effectiveness Analysis – Alternative Strengths... (cont)

- Ground-mobile (b) (7)(E) (Alt 3)

(b) (7)(E)

- UAVs (Alt 4)

(b) (7)(E)

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Summary Observations

Effectiveness Analysis – Synergies

- Point (b) (7)(E))

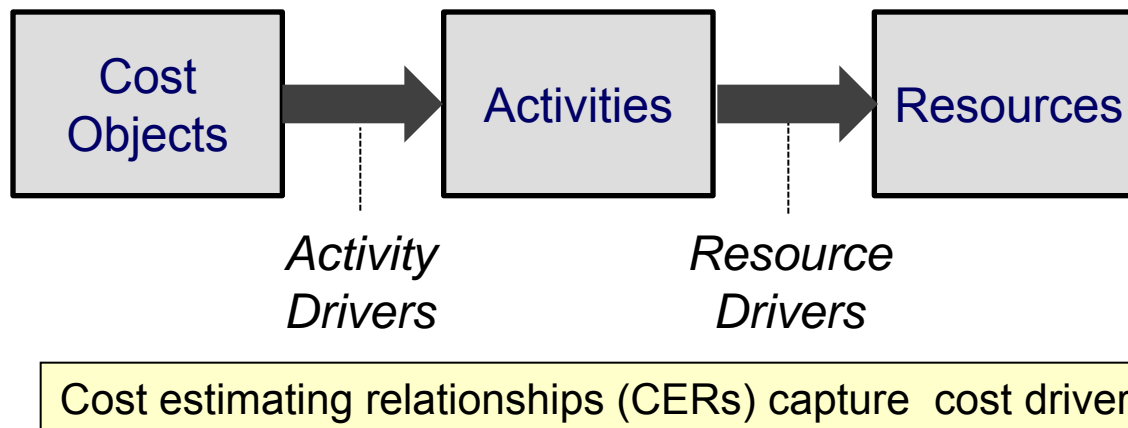
(b) (7)(E)

Outline

- **Introduction**
- **Alternatives**
- **Effectiveness Analysis**
- **Cost Analysis**
 - Cost Analysis Approach
 - Rules and Assumptions
 - Uncertainty and Risk
 - Inputs
 - Results
 - Observations
- **Summary**
- **Next Steps**

Cost Analysis Approach

- **Parametric cost estimation**
 - Uses mathematical relationships and historical knowledge base
 - Links cost and technical characteristics
- **Price Systems' True Planning® model**
 - Applied over 30+ years; calibrated over thousands of projects
 - Employs an activity-based costing framework



Ground Rules and Assumptions

- **Lifecycle period: FY11 – FY20**

- Estimates provided in Base Year (FY11) and Then Year dollars, with annual escalation at approximately 2.4%

- **Life Cycle Cost Estimate (LCCE) does not include:**

- Program Office costs
- "Sunk costs" (all costs incurred prior to October 2010)
- Operations and support cost for all existing equipment ("baseline" (b) (7)(E))
- Labor costs for existing Border Patrol personnel
 - Note: costs for additional personnel* to operate vehicles and (b) (7)(E) are included

*Additional operators:

(b) (7)(E)

- **Hardware logistics concept:**

- Replace at equipment-level, repair at organization-level

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Cost Risk

Sources and Impacts

| Alternative | Source(s) of Cost Risk | Potential Impact* |
|---|--|--|
| Alt 1 (Agent-Centric) | Equipment purchase prices | Minor |
| Alt 2 (Fixed) | IT equipment quantities and costs | Moderate |
| | (b) (7)(E) equipment costs | Minor-to-Moderate |
| | Software licensing cost growth | Minor |
| | Software maintenance level of effort | Moderate |
| Alt 3 (Mobile) | Vehicle, (b) (7)(E) operator, and equipment quantities associated with variants under this alternative | [Major; however, variants are not considered in Phase IA] |
| | Vehicle and (b) (7)(E) purchase prices | Minor-to-Moderate |
| Alt 4 (Aviation-Centric) | UAS acquisition and maintenance costs | Moderate-to-Major |
| | Ground control station (GCS) configuration | Major |
| | Non-recurring engineering (NRE) costs for avionics | [Major, but <i>not</i> included in LCCE or risk analysis—depends on potential cost-sharing agreements with USAF] |

*Analyst insight based on developing the cost model inputs; does not represent the results of sensitivity analysis.
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Cost Risk

Risk Analysis Approach

- Develop best-case, most-likely (point estimate), and worst-case estimates for each cost object
- Assume a triangular distribution of possible costs
- [REDACTED] (b) (7)(E) [REDACTED]
[REDACTED] [REDACTED]
- Provide risk-adjusted estimates at 20th and 80th percentile of cumulative distribution frequency

(b) (4)

Inputs

Alt 1 (Agent-Centric)

- Equipment quantity, basis of estimate

| Analysis Area | Agents on Patrol, per Shift* | Equipment Sets (b) (7)(E) |
|---------------|------------------------------|------------------------------|
| Area A | (b) (7)(E) | (b) (7)(E) |
| Area B | | |
| Area C | | |
| Area D | | |

“Agents on Patrol” does not include personnel at checkpoints, nor operators of baseline MSS

- Each equipment set includes

— (b) (7)(E), (b) (4)

- All equipment purchased in FY11 (replaces current inventory)
- All costs are allocable to Station / Analysis Area

Inputs

Alt 2 (Fixed) - Allocable

- **Allocable to Station / Analysis Area:**

- Towers and hardware

| | | | | | | |
|------------------------------|------------|---------------------|----------|----------|----------|----------|
| | | (b) (7)(E), (b) (4) | | | | |
| Approx Unit Cost (\$K) | | | | | | |
| Analysis Area | | Quantity | Quantity | Quantity | Quantity | Quantity |
| <u>Area A</u> | (b) (7)(E) | | | | | |
| <u>Area B</u> | | | | | | |
| <u>Area C</u> | | | | | | |
| <u>Area D</u> | | | | | | |

- COP operators

- (b) (7)(E)
- Average annual labor rate is \$70,000, with 25% Fringe

Inputs

Alt 2 (Fixed) – Allocable (cont)

■ Allocable to Station / Analysis Area (cont)

- Site preparation (b) (4)
- Lay-down & design costs (b) (4) per station)
- Station-level C2 costs (fall into one of two generic models)

| “Ajo” model (trailer-mounted COP) Applies to (b) (7)(E) | Approx Unit Cost (\$K) | “TUS” model (retrofit of existing facility) Applies to (b) (7)(E) | Approx Unit Cost (\$K) |
|---|-------------------------------|---|-------------------------------|
| ITI / hardware | (b) (4) | ITI / hardware | (b) (4) |
| Facilities | | Facilities | |

Inputs

Alt 2 (Fixed) – Non-Allocable

- **IT Infrastructure costs are considered non-allocable to Station / Analysis Area**
 - Hardware
 - Quantities and costs per 2009 Program Bill of Materials (PBOM)
 - Tech Refresh rates based on DoD standard (2 years for laptops/desktops/peripherals; 5 years for servers; 10 years for data storage units)
 - Software
 - Centrally managed software maintenance: (b) (7)(E) decreasing by 25% per year to a steady-state value of (b) (7)(E)
 - Software license costs, renewed annually

Inputs

Alt 2 (Fixed) – Not Included

- The following items are *not included* in this LCCE
 - Software costs associated with
 - Station Operations Centers
 - Station C3 centers
 - SBInet software development, integration, and testing
 - These costs are considered “sunk”
 - Software enhancements or upgrades
 - Costs for (b) (7)(E) planned for purchase with SBInet increments
 - Their effectiveness was not modeled: including these costs would skew the cost-effectiveness comparison relative to other alternatives

Inputs

Alt 3 (Mobile)

- All Alt 3 costs are allocable to Station / Analysis Area
- Equipment quantities per definition of alternative

| | Approx Unit Cost (\$K) | Additional MSS | Cerberus Lite | Additional MVSS |
|---------------|------------------------------|-------------------|------------------|--------------------|
| | | \$ | \$ | \$ |
| Analysis Area | Equipment quantities | | | |
| Area A | (b) (7)(E) | | | |
| Area B | | | | |
| Area C | | | | |
| Area D | | | | |

Inputs

Alt 3 (Mobile)

- **Additional operators**

- Number of operators derived from equipment quantities

| | | | | |
|---------------|---------------------------------|---|------------------|--------------------|
| | | Additional MSS | Cerberus Lite | Additional MVSS |
| | Operators per shift, ea item | (b) (7)(E) | | |
| Analysis Area | | Total operators (eqpmt qty x operators per shift x (b) (7) shifts) | | |
| Area A | (b) (7)(E) | | | |
| Area B | | | | |
| Area C | | | | |
| Area D | | | | |

- Average annual labor rate is \$70,000, with 25% Fringe

Inputs

Alt 4 (Aviation-Centric)

- **Non-allocable**

- Acquisition

- Costs based on CBP/OAM data and USGC estimates

| Item | Quantity | Approx Unit Cost (\$K) | Comments |
|-------------|----------|------------------------|----------|
| (b) (7)(E), | (b) (4) | | |

- Operations and Support (O&S) costs for (b) (7)(E) (b) (7)(E) (b) (7)(E), and hangar

Inputs

Alt 4 (Aviation-Centric)

■ Allocable to Station / Analysis Area

- Flying hour costs

- (b) (7)(E)
 -

- Costs per fh include:

- Flight crew
 - Operations
 - Fuel
 - UAS maintenance

Results: Summary

10-Year Life Cycle Cost Estimate, Then-Year \$M

| Area A | Alt 1 | Alt 2 | Alt 3 | Alt 4 |
|-----------------------------|------------------------------|---------|----------|--------------------|
| (b) (7)(E) | (Agent-Centric) | (Fixed) | (Mobile) | (Aviation-Centric) |
| Allocable to Station / Area | (b) (7)(E), (b) (4), (b) (5) | | | |
| Non-Allocable | | | | |

| Area C | Alt 1 | Alt 2 | Alt 3 | Alt 4 |
|-----------------------------|------------------------------|---------|----------|--------------------|
| (b) (7)(E) | (Agent-Centric) | (Fixed) | (Mobile) | (Aviation-Centric) |
| Allocable to Station / Area | (b) (7)(E), (b) (4), (b) (5) | | | |
| Non-Allocable | | | | |

| Area B | Alt 1 | Alt 2 | Alt 3 | Alt 4 |
|-----------------------------|------------------------------|---------|----------|--------------------|
| (b) (7)(E) | (Agent-Centric) | (Fixed) | (Mobile) | (Aviation-Centric) |
| Allocable to Station / Area | (b) (7)(E), (b) (4), (b) (5) | | | |
| Non-Allocable | | | | |

| Area D | Alt 1 | Alt 2 | Alt 3 | Alt 4 |
|-----------------------------|------------------------------|---------|----------|--------------------|
| (b) (7)(E) | (Agent-Centric) | (Fixed) | (Mobile) | (Aviation-Centric) |
| Allocable to Station / Area | (b) (7)(E), (b) (4), (b) (5) | | | |
| Non-Allocable | | | | |

Non-allocable costs include:

Alt 2: Network Operations Center/Security Operations Center (NOC/SOC); Remote Terminal Unit (RTU); and centrally-managed, custom-developed Common Operational Picture (COP) software

Alt 4: procurement of (b) (7)(E); plus operation and support costs for (b) (7)(E)

Results

Depicting “Allocation Uncertainty”

- **Problem:** how to depict Non-Allocable costs in a comparison of individual Station / Analysis Area results
- **Solution:** for Area X...

(b) (7)(E), (b) (5)

Results: Summary

Cost Risk and Allocation Uncertainty

(b) (7)(E), (b) (4), (b) (5)

Allocation uncertainty dominates the comparison

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Summary Observations

Cost Analysis – Uncertainty

- **The cost comparison is dominated by the “allocation uncertainty”**
 - Comparing the cost of SBInet to the cost of other technology solutions for one particular station or area is difficult without knowing how broadly the fixed (nonallocable) costs for the SBInet IT architecture will be distributed
 - Unlike operational effectiveness comparisons, which are driven by local (station or area-unique) variables, cost comparisons are driven by the larger “game plan”

Summary Observations

Cost Comparison of Alternatives

- Alt 1 (Agent-Centric)
 - Lowest cost ; very low cost risk
- Alt 2 (Fixed)
 - Significant IT infrastructure costs
 - Its cost-effectiveness will be largely determined by determining how widespread is the area over which it represents the “best” (most operationally effective) solution
- Alt 3 (Mobile)
 - Somewhat lower in cost than Alt 2
 - Comparison to Alt 4 is highly dependent on area-unique terrain and access, which drive vehicle quantities
 - Personnel costs are significant share of Alt 3; cost risk is very low
- Alt 4 (Aviation-Centric)
 - Significant infrastructure plus highest cost risk

Outline

- **Introduction**
- **Alternatives**
- **Effectiveness Analysis**
- **Cost Analysis**
- **Summary**
 - Cost-Effectiveness Comparisons
 - The Larger View
- **Next Steps**

Cost Effectiveness Comparison

Approach for a Single Study Area

(b) (7)(E), (b) (4), (b) (5)

Cost-Effectiveness Comparison

Analysis Area A - (b) (7)(E)

(b) (7)(E), (b) (4), (b) (5)

Effectiveness Index

Note: the range of costs does not reflect cost risk *per se*, but “allocation uncertainty” – the fact that in a comparison over a single geographical area, we do not know how broadly the fixed (nonallocable) costs for some alternatives will be spread. The vertical “cross-hair” does ***not*** necessarily reflect the “most likely cost.”

10-Year Life-Cycle Cost, Then-Year \$M

Cost-Effectiveness Comparison

Analysis Area B – (b) (7)(E)

(b) (7)(E), (b) (4), (b) (5)

Effectiveness Index

Note: the range of costs does not reflect cost risk *per se*, but “allocation uncertainty” – the fact that in a comparison over a single geographical area, we do not know how broadly the fixed (nonallocable) costs for some alternatives will be spread. The vertical “cross-hair” does ***not*** necessarily reflect the “most likely cost.”

10-Year Life-Cycle Cost, Then-Year \$M

Cost-Effectiveness Comparison

Analysis Area C - (b) (7)(E)

(b) (7)(E), (b) (4), (b) (5)

Effectiveness Index

Note: the range of costs does not reflect cost risk *per se*, but “allocation uncertainty” – the fact that in a comparison over a single geographical area, we do not know how broadly the fixed (nonallocable) costs for some alternatives will be spread. The vertical “cross-hair” does ***not*** necessarily reflect the “most likely cost.”

10-Year Life-Cycle Cost, Then-Year \$M

Cost-Effectiveness Comparison

Analysis Area D - (b) (7)(E)

Effectiveness Index

(b) (7)(E), (b) (4), (b) (5)

Note: the range of costs does not reflect cost risk *per se*, but “allocation uncertainty” – the fact that in a comparison over a single geographical area, we do not know how broadly the fixed (nonallocable) costs for some alternatives will be spread. The vertical “cross-hair” does ***not*** necessarily reflect the “most likely cost.”

10-Year Life-Cycle Cost, Then-Year \$M

Cost-Effectiveness Comparison

Observations

- With regard to the decision focus of the Phase IA effort...

(b) (7)(E)

- Therefore, we considered Question 1:

(b) (7)(E), (b) (5)

Cost-Effectiveness Comparison

Excursion – MOE 4.0 (Agility) Weight = 0

(b) (7)(E), (b) (4), (b) (5)

Effectiveness Index

Note: the range of costs does not reflect cost risk *per se*, but “allocation uncertainty” – the fact that in a comparison over a single geographical area, we do not know how broadly the fixed (nonallocable) costs for some alternatives will be spread. The vertical “cross-hair” does ***not*** necessarily reflect the “most likely cost.”

10-Year Life-Cycle Cost, Then-Year \$M

An Answer ... and More Questions

(b) (7)(E), (b) (5)

Extrapolation to Other AZ Border Areas

- Cost estimates are based on parameters that can be readily be applied to other stations in AZ

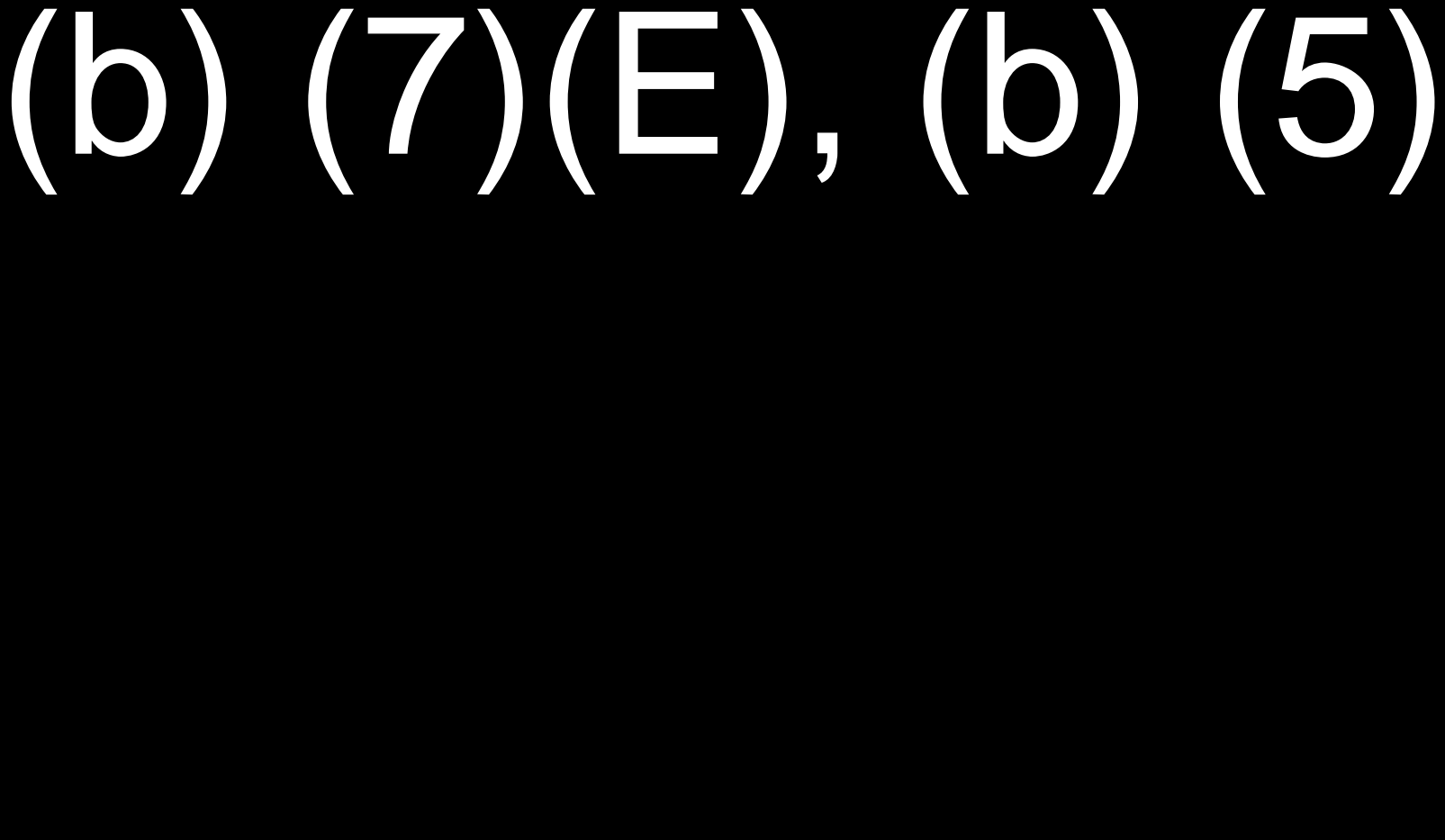
| Estimated ROM <u>10-Year</u> LCC (\$M, then-year dollars) | | | | | |
|--|--|------------------------------|-------------|------|----|
| | | 1 | | | |
| | | Agent-Centric | | | |
| | | Low | Most Likely | High | Lo |
| Costs Allocable by Station | | (b) (7)(E), (b) (5), (b) (4) | | | |
| | | | | | \$ |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

- Operational effectiveness analysis is more difficult to extrapolate; however, there are ways we could do this...

Analysis of AZ Border

- Correlation to established border zone terrain types

(b) (7)(E), (b) (5)



Analysis of AZ Border (cont)

- **Statistical analysis** [REDACTED] (b) (7)(E)

- Example: [REDACTED] (b) (7)(E)

(b) (7)(E)

Discussion and Next Steps



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